UTILITY PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	10/705,579	Confirmation No. 4256
Docket No.	:	004.0048	
Applicant	:	Sridhar K. Kailasam	Filed: November 10, 2003
Examiner	:	Rodgers, Colleen E.	TC/A.U.: 2813

DECLARATION OF ROEY SHAVIV PURSUANT TO 37 C.F.R. 1.132

I, Dr. Roey Shaviv, declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1000 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application and of any patent issuing therefrom.

1. I am Senior Technologist and IP Executive of Novellus Systems, Inc. ("Novellus"), assignee of U.S. Patent Application 10/705,579. I have been employed by Novellus for 5 years.

2. I received a Ph.D. in Chemistry from the University of Michigan in 1988.

3. I have reviewed U.S. Patent Application 10/705,579 and am familiar with its contents.

4. I have reviewed U.S. Patent 7,135,404 B2, issued to Baskaran et al. on November 14, 2006 (hereinafter "Baskaran") and understand that it is being asserted against claims 28, and 55 -57 of the instant application.

5. Baskaran differs from independent claim 55 of the instant application because Baskaran does not teach applying a "pulse" to a barrier layer deposited on a work piece. That is, Baskaran does not disclose applying an initial cathode current pulse of no less than about 25 mA/cm^2 for about 0.5 to about 10 seconds. Rather, Baskaran

teaches a cathodic treatment of 10 mA/cm^2 or higher for about 15 seconds to one minute. This is an important difference.

6. Pursuant to the laws of thermodynamics, the amount of contaminant material (typically organic residues) and/or oxides that is removed from the barrier layer surface during application of a current is proportional to the amount of current that passes between the reactants. In other words, the integral under the current versus time curve ($_{t=0}\int^{t=\Delta t} I \cdot dt$) determines the amount of reaction that takes place. The difference is in the kinetics. When a reactant is a contaminant or dielectric (such as a metal oxide), the activation energy is higher than when the reactant is a conductor. Applying a "pulse" of no less than about 25 mA/cm^2 for about 0.5 to about 10 seconds overcomes the threshold to the reaction as defined by the activation energy. The dielectric metal oxide or contaminants thus react faster than if a lower current is applied. The use of a cathode current having a magnitude of only 10 mA/cm^2 is too low to provide adequate removal of the contaminants and/or oxides unless applied for a significantly long period of time. This long time period would be significantly inefficient and would adversely affect product throughput.

7. If the cathodic treatment of Baskaran were conducted at 25 mA/cm^2, as taught by the instant application, for 15 seconds or more, as taught by Baskaran, the effects may be detrimental. During the electrodeposition of copper, the process should be carefully controlled to insure uniform bottom-up deposition, that is, deposition without a significant amount of voids and/or defects and to insure that small dimensioned features are filled at substantially the same rate as large dimensioned features. However, a cathodic treatment of Baskaran that uses such high current for a long amount of time may not only result in the removal of the contaminants and oxides but also result in a quick and, thus, less controllable electrodeposition of copper for the remaining time. A less controllable electrodeposition process can result in a lower quality copper fill, which can adversely affect device operation.

8. Further, a pulse of no more than 10 seconds is fifty percent (50%) faster than an electrolytic treatment of 15 seconds. This increase in process time provides a significant production advantage.

Date: 4/9/2007

Dr. Roey Shaviv